Costs and Benefits of Apprenticeship Training

A Comparison of Germany and Switzerland*

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Abstract

For the first time it has been made possible to merge a German and a Swiss firm-level data set that include detailed information about costs and benefits of apprenticeship training. Previous analyzes based only on aggregate data showed that the net costs of training apprentices are substantial in Germany, whereas apprenticeship training is on average profitable during the training period for firms in Switzerland, even though the two training systems are rather similar. This paper analyzes the reasons for these differences with matching methods. We simulate the impact of changes in certain parameters such as wages, apprenticeship system-related factors and allocation of tasks to apprentices on the cost-benefit ratio using the counterfactual values of the other country. The results show that most of the difference in the net costs of training between the two countries can be explained by a higher share of productive tasks allocated to apprentices in Switzerland and the differences in relative wages.

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JEL Classification: J24, J31, J44

1. Introduction

Over the past decades, a number of surveys have been conducted in Germany and Switzerland that analyzed the costs and benefits of apprenticeship training from the firm's perspective.[1] Recent empirical research for Switzerland showed

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[1] See Noll et al. (1983), von Bardeleben et al. (1991, 1995, 1997) and Beicht et al. (2004) for Germany or Schweri et al. (2003) and Muehlemann et al. (2007) for Switzerland. Wolter (2008) gives an overview of the development and the use of cost-benefit analyzes for apprenticeship training since the survey of the so-called "Edding-commission" in 1974 (Sachverständigenkommission Kosten und Finanzierung der beruflichen Bildung 1974); see also section 2.1.

that the training behavior of a firm is influenced significantly by the net costs of an apprenticeship program, either directly (see Wolter et al., 2006; Muehlemann et al., 2007) or indirectly by factors related to the net costs of training (see Muehlemann and Wolter, 2007). Walden (2007) in a replication of the Swiss analysis concludes that costs and benefits also play a significant role in the company training behavior in Germany, although the impact of the net costs is smaller compared to Switzerland. Nevertheless, these economic factors play an important role in apprenticeship training, even though economists have neglected the analysis of the dual apprenticeship system for quite some time.

In this paper, we make a comparison of the cost-benefit situation of firms that train apprentices in two countries where the dual vocational education and training (VET) system is very important and has a long tradition: Germany and Switzerland.[2] Despite the institutional and structural similarities of the dual VET systems, the cost-benefit situation for firms that train apprentices is very different if we compare the two countries at the aggregate level. Apprenticeship training on average is profitable in Switzerland already during the training period, whereas German firms bear substantial net costs of training apprentices.

This empirical finding is the starting point of our analysis. So far, it was argued that structural differences between the two countries, such as different training occupations, a different industry structure, firm characteristics like firm size or different relative wages of apprentices and skilled workers could account for these differences. Furthermore, Germany and Switzerland also differ by a large degree with regards to labor market regulations and institutions. In Germany, unions have a much stronger influence and it is more difficult to lay off workers compared to Switzerland. As well, German work councils can directly influence the firm's strategy at the micro level, which includes the training of young workers. The studies by Acemoglu and Pischke (1998, 1999a, b) and Franz and Soskice (1995) highlight the importance of labor market institutions and frictions with regards to the firm's decision to provide training. The contribution of this paper to the literature is that for the first time we can analyze the cost-benefit ratio of apprenticeship training of two countries that have a similar VET system, but differ substantially with respect to labor market regulations and institutions.[3]

Our results show that the difference in net costs of training cannot solely be attributed to structural differences of the two countries. Using matching methods, we find that the allocation of tasks to apprentices at the workplace is an important

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[2] In both countries, more than half of a cohort of school leavers enrolls in a dual apprenticeship program.

[3] In the OECD Employment Outlook (OECD, 2004), the value of the overall index for employment protection legislation in the year 2003 is 2.5 for Germany and 1.6 for Switzerland. As a comparison, the United States have a value of 0.7, the United Kingdom 1.1, whereas Sweden and Norway have a value of 2.6 and France a value of 2.9. Germany is ranked in the top third of the countries with highest index of employment protection legislation, whereas Switzerland is situated in the lowest quartile.

determinant of the difference in the net costs of training. The effect is even more pronounced if the wage-level of skilled workers is high. As a result, the benefits of training, i.e. the value of the productive work of apprentices, is much higher in Switzerland than in Germany and constitutes the main source for the difference in the cost-benefit ratio between the two countries.

The paper is organized as follows: First, we discuss the costs-benefit surveys of apprenticeship training and provide descriptive statistics. The following section describes the econometric modeling and the estimation strategy. Section 4 presents the empirical results. Section 5 discusses the implications of our findings. Section 6 concludes.

2. Cost-benefit-surveys and data

In this section, we introduce the concepts and the methodology of the cost-benefit-surveys of apprenticeship training and present descriptive results for Germany and Switzerland.

2.1 Cost-benefit-surveys of apprenticeship training

The concepts of cost-benefit-surveys of apprenticeship training have been developed by the "Expert Commission on Costs and Financing of Vocational Education and Training" in 1974, which is also known as the "Edding-Commission". In our analysis, we use two surveys that were conducted simultaneously in Germany (see Beicht et al. 2004) and Switzerland (Schweri et al. 2003), both with the same reference year (2000).

From a methodological point of view, the results of the two surveys are comparable, even though there are some differences with regards to how they were conducted.[4] Nevertheless, most questions have been posed in exactly the same way, as the Swiss questionnaire was based on the German questionnaire.[5]

However, even though the questions are mainly identical, Beicht et al. (2004) applied two different methods to calculate costs and benefits. The main difference is that the first method does not include expenses for part-time training personnel, whereas the second method does. To maximize the comparability of the two surveys, the German costs and benefits of training have been re-calculated with the

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[4] In Germany, the survey was conducted by personal interviews, while Swiss firms were sent written questionnaires and have subsequently been contacted by phone for remaining questions.

[5] The wording of some questions was slightly different, e.g. Swiss firms were asked about the share productive and non-productive tasks of their apprentices at the workplace, whereas German firms could differentiate further between three sub-categories for non-productive tasks. While such differences could result in a somewhat different response-behavior of firms, it should not affect the comparability.

model used in the Swiss survey, which is very similar to the second method of the German survey.

2.2 The cost-benefit model

The average yearly costs of apprenticeship training mainly consist of the average yearly wages of apprentices w_a and the costs for the training personnel. The latter are given by the product of average yearly hours of instruction time h_{ti} and the respective hourly wage w_t of training personnel, which can be either management, full-time trainers, skilled workers or unskilled workers. In addition, there are expenses for material, infrastructure, external courses, costs for hiring and administration of apprentices and other, denoted by X.[6] This yields the following costs for firm i:

$$(1) \qquad\qquad c_i = w_{ai} + h_{ti}w_{ti} + X_i$$

where c_i denotes the costs for an average year of the training period per apprentice. The calculation of training costs suggests that they are mainly determined by wages. Hence, differences in training costs between firms are primarily due to variables that influence either the wage of apprentices or the wage of training personnel. The calculation of the benefits b is based on the type of work the apprentices perform. An apprentice spends a fraction α of his productive working time h performing activities that would otherwise be carried out by unskilled workers. In the remaining time $(1-\alpha)h$, the apprentice performs skilled work. In the first case, we can assume that the apprentice's performance has the same value as that of an unskilled worker, i.e. the wage of an unskilled worker w_u. However, the value of the apprentice's performance for an hour of skilled work is less than the hourly wage w_s of a fully trained skilled worker. The values of the apprentice's work has to be adjusted by a relative productivity measure γ, since apprentices are not yet as efficient as a skilled worker with a vocational degree. Hence, the benefits of training to firm i are given by

$$(2) \qquad\qquad b_i = [\alpha w_{ui} + (1-\alpha)\gamma w_{si}]h$$

where b_i denotes the benefits for an average year of training per apprentice. The net costs C of training an apprentice are the difference between the costs c and the benefits b. As a result, the net costs of an average year of training per apprentice for firm i are given by

$$(3) \qquad\qquad C_i = c_i - b_i .$$

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[6] For details on the cost-benefit model see Schweri et al. 2003.

2.3 Data and sample selection

The data in this paper are from two firm-level surveys on the costs and benefits of apprenticeship training. The first survey was conducted in Germany by the Federal Institute for Vocational Education and Training in Bonn (Beicht et al. 2004), whereas the second study has been carried out by the Centre for Research in Economics of Education at the University of Berne (see Schweri et al. 2003). All results presented in this article are weighted by sampling weights that account for the stratified sampling.[7] The analysis focuses only on apprenticeship programs that last three years, since programs exceeding three years last 3.5 years in Germany, but four years in Switzerland, which would make a comparison less meaningful. The sample used for the analysis consists of 1825 German and 1471 Swiss firms.

2.4 Descriptive statistics

The cost-benefit ratio of apprenticeship training from the firm's perspective between Germany and Switzerland differs significantly (see Tables A.1 and A.2 in the Appendix for descriptive statistics). The average costs of training c amount to 15,536 € in Germany. The corresponding value for Switzerland is 18,131 €.[8] This results in Δc between Germany and Switzerland of 2595 € per year, which amounts to 7785 € in total for a three-year training program. This difference is substantial, but relatively small compared to the difference in the benefit of training. The value of the productive contribution of apprentices is much higher in Switzerland, where the average benefit b amounts to 19,044 €. In Germany, b is on average 8008 € per year and per apprentice.[9] Hence, apprenticeship training in Germany results in net costs C of 7528 € p.a., whereas in Switzerland, firms can generate an average net benefit of 913 €. As a result, ΔC between Germany and Switzerland for a three-year apprenticeship program equals 25,323 €. Figure A.1 shows a histogram of the net costs for Germany and Switzerland. It can be seen that the distributions of net costs are fairly similar. However, it can be observed that the distribution of the net costs for Germany is shifted to the right, i.e. net costs are higher compared to Switzerland. This large difference in net costs is the starting point of our analysis. We first focus on the components of the net costs, to see

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[7] For the calculation of the weights for the Swiss survey see Renfer (2002) and Potterat (2003). For documentation on the calculation of the weights for the German survey see Schröder et. al. (2001).

[8] To convert the results of the Swiss survey (which are reported in CHF) into €, we used the exchange rate on September 1st, 2000 (1 CHF = 0.64687 €).

[9] In two recent papers, Zwick (2007) and Mohrenweiser and Zwick (2008) dispute the finding that German firms incur high net costs of training. On the basis of firm-level panel data the results show that there is no significant difference in the overall impact on gross profit due to a marginal increase in the share of apprentices compared to the effect of an increase in the share of unskilled workers. Without going into details, we do not think these results reveal anything about net costs of training.

whether they already show large differences in a bivariate analysis. The main components of the costs c are wages for training personnel w_t and wages of apprentices w_a. The average wage for a management position is 46 % higher in Switzerland, whereas the wage for full-time training personnel is 24 % higher compared to Germany. Wages of skilled workers (administrative, technical / social, crafts) exceed the German values by 60 %, 53 % and 71 %. Last, the monthly wage of a worker without a vocational degree is 59 % higher in Switzerland compared to Germany.[10] In contrast to the wage level for workers, the wage costs for apprentices w_a are on average higher in Germany than in Switzerland. For the first and the second year German apprentices wages are higher ($\Delta w_{a1} = 1344$ €, $\Delta w_{a2} = 456$ €), but lower in the third year of the training program ($\Delta w_{a3} = -981$ €).

Further differences can be attributed to the number of days that apprentices are required to spend in a vocational school. The average difference between Germany and Switzerland amounts to 15 days in the first, 10 days in the second and 8 days in the third year of training. This is the main reason why Swiss apprentices spend more days per year at the workplace within the training firm. In addition, German apprentices also spend more days in internal and external courses and internships in other establishments. As a result, Swiss apprentices spend more time at the workplace compared to German apprentices (+23 days in the first year, +18 days in the second year and +13 days in the third year).

Independent of the time apprentices spend in firms, major differences in terms of net costs of training may occur due to the type of work and training within the firm. Firms have a large degree of freedom with respect to the allocation of tasks to apprentices during the time they spend at the workplace. They can perform productive activities (either tasks usually performed by skilled workers or tasks usually performed by unskilled workers, i.e., workers without a vocational degree), or activities that have no direct value to the firm (e.g., time for practicing or instruction time at the workplace).

The differences between Germany and Switzerland with respect to these parameters are substantial. The share of the time allocated to non-productive activities to German apprentices exceed the corresponding values for Swiss apprentices by 36 %-points in the first year, 28 %-points in the second year and 18 %-points in the third year. Over a whole apprenticeship period, Swiss apprentices spend 468 days at the workplace and spend 83 % of this time with productive tasks, while German apprentices spend a total of 415 days at the workplace and spend 57 % of their time with productive tasks.

However, the respective shares of qualified and unqualified productive activities do not differ much between the two countries. This also means that the higher

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[10] On the other hand, non-wage labor costs are higher in Germany (37.3 % of the wage on average) than in Switzerland (23 % of the wage on average). Wages and non-wage labor costs in our surveys match official statistics, see Statistisches Bundesamt (2003) for Germany and Bundesamt für Statistik (2002) for Switzerland.

share of productive activities of Swiss apprentices is not due to a higher share of unqualified labor compared to Germany. In line with these findings, the relative productivity of apprentices performing skilled work increases by the same amount over time; i.e., from 37% in the first year to 75% in the final year of the apprenticeship program in Switzerland and from 30% to 68% respectively in Germany. This is also an indication that the two apprenticeship training systems lead to comparable outcomes, in the sense that the relative performance of the apprentices compared to skilled workers in the final year of the training program is almost the same in both countries (see also descriptive results in the Appendix).

Although the differences in some of the parameters of the costs and benefits are substantial, we start by testing how much of the total difference in the net costs between the two countries can be explained by structural differences alone. To do so, we run a series of OLS-regressions (see Table A.3). The results show that the difference between Germany and Switzerland, i.e., the dummy variable *German firm,* does not decrease if control variables for firm size (model 2), industry (model 3), occupation categories (model 4) and indicators for firms having a company training center and full-time training personnel (model 5) are included. While some of these control variables significantly influence the net costs of training apprentices, the impact of being a firm located in Germany remains constant.

3. Empirical modeling

The results in Table A.3 show that the large differences in the net costs of training between Germany and Switzerland cannot be explained by structural variables such as industry, firm size or training occupation. However, since the net costs are the result of a constructed cost-benefit model where all parameters are known, it must be possible to explain these differences. Unfortunately, it is not possible to simply apply an OLS-regression and include these parameters as independent variables, since they all enter the net costs by construction. Instead of trying to directly estimate the effects of these parameters on the net costs, we apply matching-models analogous to the treatment effects literature.[11] However, instead of estimating the effects of e.g. an active labor market program of unemployment, we estimate the effect of hypothetically moving a firm step by step to the other country by changing the parameters in the net cost equation that showed the largest differences in the descriptive analysis. After doing this, we re-calculate the cost-benefit model for each firm and as a result we obtain a new estimate of the net costs of training apprentices. This procedure enables us to determine how much of the difference between Germany and Switzerland can be explained by these parameters.

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[11] For seminal work on matching methods see, among others, Rubin (1974) and Rosenbaum and Rubin (1983).

Let the observed outcome be denoted by Y_i:

$$(4) \qquad Y_i = Y_i(D_i) = \begin{cases} Y_i(0) & \text{if} \quad D_i = 0 \\ Y_i(1) & \text{if} \quad D_i = 1 \end{cases}$$

where D_i, for $D_i \in 0, 1$ is the treatment indicator, i.e., whether observation i is a firm located in Germany ($D_i = 1$) or Switzerland ($D_i = 0$). Formally, we are interested in the average treatment effect on the treated (ATT), which can be interpreted as if a German firm faces the environment of a Swiss firm, such that

$$(5) \qquad ATT_i = E[Y_i(1) - Y_i(0)|D_i = 1].$$

We are also interested in the average treatment effect on the controls (ATC), which can be interpreted in a way that a Swiss firm faces the environment of a German firm, such that

$$(6) \qquad ATC_i = E[Y_i(1) - Y_i(0)|D_i = 0].$$

If an individual or a firm could self-select in a treatment group, then the matching estimator would be biased. In our case the treatment cannot be interpreted as random, but the unconfoundedness assumption (see Rosenbaum and Rubin 1983) is assumed to hold.[12] Hence, the assumption that the treatment D_i is independent of the outcome variables $(Y(0), Y(1))$, i.e., the parameters of the net costs of apprenticeship training, still holds.

We apply a simple matching estimator (see Abadie et al., 2004) to estimate the counterfactual outcome, i.e., the value that is not observed for firm i. While the observed outcome is its own estimate, the unobserved outcome is estimated by averaging the outcomes of the most similar firms in the other country, such that

$$(7) \qquad \hat{Y}_i(0) = \begin{cases} Y_i & \text{if} \quad D_i = 0 \\ \dfrac{1}{\#\mathcal{J}_M(i)} \sum_{l \in J_{M(i)}} Y_l & \text{if} \quad D_i = 1 \end{cases}$$

and

$$(8) \qquad \hat{Y}_i(1) = \begin{cases} \dfrac{1}{\#\mathcal{J}_M(i)} \sum_{l \in J_{M(i)}} Y_l & \text{if} \quad D_i = 0 \\ Y_i & \text{if} \quad D_i = 1 \end{cases}$$

where $\mathcal{J}_M(i)$ denotes the set of indices for the matches for a firm i (for more details see Abadie et al. 2004).

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[12] The matching estimates would be biased if firms had chosen their location based unobserved factors that are related to parameters of the net costs of apprenticeship training. Since apprenticeship training is usually not the core business of a firm, we assume that firms base their location decision on other factors unrelated to the costs of apprenticeship training.

The estimation strategy is as follows:

1. In a first step, we estimate the treatment effects on a number of variables that are relevant to the net costs of apprenticeship training. The descriptive statistics (see section 2.4) show that the main differences between Germany and Switzerland can be attributed to the following parameters:

   – Wages of apprentices and skilled workers and non-wage labor costs.

   – Parameters related to the VET system and labor market regulations that affect the number of days where apprentices are at the workplace of the training firm: the number of days that apprentices spend in vocational school, external and internal courses, vacation and sick days as well as internships in other firms.

   – The allocation of tasks to apprentices at the workplace, i.e., the share of tasks that have direct value to the firm and the share of tasks that do not have a direct value to the firm.

   The matching is conducted using a set of independent variables including firm size, industry, occupation categories and two binary variables indicating whether the firm has a separate company training center and whether the firm employs full-time training personnel.

2. Having obtained counterfactual values for the parameters of interest, both for German firms hypothetically facing the environment of a Swiss firm ($\hat{Y}_i(1)$ if $D_i = 0$) and for Swiss firms hypothetically facing the environment of a German firm ($\hat{Y}_i(0)$ if $D_i = 1$), we can now re-calculate the underlying cost-benefit model (see section 2.2) at the firm-level, while all other parameters of the model remain unchanged. As a result, we get a new estimate for the costs and benefits of apprenticeship training.

4. Results

In this section, we present the results of our simulations based on the matching-models. The first subsection presents the results for German firms receiving treatment for a Swiss firm environment, whereas the following subsection presents the opposite case, i.e. Swiss firms receiving treatment for a German firm environment.

4.1 Treatment effects on German firms

We first estimate all treatment effects individually to get a notion of the relative magnitude of the individual parameters and in a second step we will simultaneously estimate all treatment effects together.

The first parameters to change are wages. German firms receive a treatment for wages of skilled workers and apprentices as well as non-wage labor costs,

such that they match the situation of a comparable Swiss firm. The average treatment effects on the treated $ATT_i = E[Y_i(1) - Y_i(0)|D_i = 1]$ are presented in Table A.6. Average monthly wages for skilled workers are about 1,300 € higher in Switzerland; hence the costs of training increases because the time for training personnel becomes more costly for a German firm facing Swiss wages. However, the effects of higher wages on the net costs of training are ambiguous, since a higher wage-level also increases the value of productive work that is carried out by apprentices. The results show that the costs of apprenticeship training increase by 2214 € p.a. and per apprentice, whereas average benefits increase by about 3340 € (see Table 1). Hence, the overall effect of higher wage costs is negative and leads to a decrease in the net costs of training by 1126 €.

Table 1

Effects of treatment on costs and benefits for German firms

Treatment	Δ Costs	Δ Benefits	Δ Net costs
Wages	2214	3340	–1126
VET-system	326	869	–543
Allocation of tasks to apprentices	–69	2865	–2934

Change in € compared to original values.

The second group of parameters that get treated are related to regulations of the VET-systems and labor market regulations, i.e. the number of days that apprentices are away from the firm because of vocational school, external and internal courses, vacation and sick days. The average treatment effects on the treated are presented in Table A.7. The effects of these parameters on the net costs for a firm are smaller compared to the wage effects. The costs of training increase by 326 € (the apprentice spends more time at the firm now, which increases training costs) and the benefits increase by 869 € (see Table 1). This leads to a decrease in net costs of training by 543 € for a German firm.

In a third step, German firms receive treatment with respect to the allocation of tasks to apprentices at the workplace. As shown in the descriptive statistics (see section 2.4), there are large differences between the two countries. This has obviously a sizeable impact on the net costs of training apprentices. The treatment effects on the treated with respect to the share of non-productive work are large and highly significant (see Table A.8). Having obtained the counterfactual values, we re-calculate the cost-benefit model again and find that due to a now increased productive contribution of the apprentices the net costs of training decrease by 2934 € p.a. (see Table 1). The effects described above are economically substantial and add up to 4603 €. This explains 55 % of the initial difference in net costs between Germany and Switzerland.

Table 2

Costs and benefits after treatment for German firms

Treatment	Costs	Benefits	Net costs
None	15536	8008	7528
Wages	17750	11348	6402
Wages & VET-system	18205	12679	5526
Wages & VET-system & Task-allocation	18066	17132	934

Absolute values in €.

However, it can be suspected that changes in some parameters affect other parameters as well; e.g. an increased share of tasks to apprentices that have a direct productive value to the firms is expected to result in a larger benefit of training if the wages of skilled workers are high, i.e., an hour of work by an apprentice is then worth more to the firm (ceteris paribus). Similarly, at given wages and a given allocation of tasks, the productive value of apprentices should increase if they spend more days per year at the workplace. Therefore, all parameters of interest (wages, VET-system, allocation of tasks to apprentices) get treated simultaneously and we then re-calculate the cost-benefit model again. If a German firm face Swiss wage-levels, the parameters of the Swiss VET-system and allocate the share of productive and non-productive tasks in a manner that a comparable Swiss firms does, then the net costs of training for a German firm decline by 6594 € to 934 € p.a. and per apprentice (see Table 2).

Summarizing the results, the main factors that account for the large difference in the net costs of training are the wage-levels of skilled workers and apprentices as well as the time allocation within the firm. The latter is the most important and reduces initial net costs by 61%, given the *simulated* values for Swiss wages and the Swiss VET-system. It should be noted that the allocation of tasks per se has less of an influence in Germany where *observed* wages are lower and apprentices spend less time within the company (see Table A.4), it then explains only 35% of the difference in net costs.

By simulating a change in all three parameters above, 78% of the initial difference between Germany and Switzerland (which is equal to 8441 €) can be explained by these three groups of parameters.[13] As can be seen in Table A.4, this difference remains robust and significant in an OLS-Regression that includes structural variables as controls.

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[13] It should be noted that the number of training hours as well as the relative productivity of apprentices compared to skilled workers within the training firm have not been affected by the simulation, i.e., they were held constant. Reason being that a change in training hours would result in a change of the relative productivity as well. However, the size of this effect cannot be determined with the data at hand and the net effect of such changes is prima facie not clear.

4.2 Treatment effects on Swiss firms

The procedure outlined above can also be applied to Swiss firms. Instead of using the original parameter values of interest, $E[Y_i(0)|D_i = 0]$ to calculate the costs and benefits, we now use the estimates of the parameter values $E[Y_i(0)|D_i = 1]$ to re-calculate the new cost-benefit situation if a Swiss firm had to face the environment of a German firm with respect to the parameters of interest. In the absence of treatment, training apprentices is profitable on average in Switzerland. If a Swiss firm receives treatment with respect to wages, the net costs increase by 3989 € (see Table 3). The reason for this large effect is that the value of the apprentice's productive work at a lower wage-level decreases by more than the costs of training personnel. In addition, the effect of a change in wages is stronger for Swiss firms than for German firms (as shown above in Table 1) because Swiss apprentices spend more time with productive activities at the workplace.[14]

Table 3

Effects of treatment on costs and benefits for Swiss firms

Treatment	Δ Costs	Δ Benefits	Δ Net costs
Wages	−1852	−5841	3989
VET-system	−455	−2306	1851
Allocation of tasks to apprentices	−111	−5998	5887

Change in € compared to original values.

The benefits of training apprentices decrease as well if Swiss firms receive treatment for the VET-system. Since apprentices are less available to the firm under the German regime, net costs increase by another 1851 €. As it is the case for German firms, the allocation of productive and non-productive tasks to the apprentices explains the largest part of the difference in the net costs of training between Germany and Switzerland, i.e., net costs increase by 5887 € due to a now lower value of the productive contribution of an apprentice.

Adding up the individual effects, net costs of apprenticeship training increase by 11,727 €, which is more than the observed difference between the two countries. The reason why the sum of the individual effects is so large is again a simultaneity problem. A change in wages has a larger effect if the share of productive tasks assigned to apprentices is high, and vice versa. Therefore, we re-calculate the cost-benefit model again including the treated parameters of interest simultaneously, as in the previous subsection 4.1. The results show that the expected net costs of apprenticeship training for a Swiss firm facing the environment of a German firm

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[14] See Table A.6 for the average treatment effects on the controls, i.e., $ATC_i = E[Y_i(1) - Y_i(0)|D_i = 0]$.

with respect to our parameters of interest amount to 7918 € p.a. and per apprentice (Table 4). These simulated net costs exceed the observed average net costs of apprenticeship training in Germany by 390 € p.a. and per apprentice. As can be seen in Table A.5, this difference is not significant in an OLS-Regression and remains insignificant if structural variables are included as controls.

Table 4

Costs and benefits after treatment for Swiss firms

Treatment	Costs	Benefits	Net costs
None	18131	19044	–913
Wages	16279	13202	3077
Wages & VET-system	15971	11620	4351
Wages & VET-system & Task-allocation	15924	8006	7918

Absolute values in €.

The results also imply that the high wage-level of skilled workers in Switzerland is a big incentive for Swiss firms to substitute skilled work by apprentices. A larger share of productive tasks for apprentices would also have a strong impact on the net costs of German firms, but compared to Switzerland, the effect is weaker because of the lower wage-level in Germany.

5. Discussion

The findings of the different cost-benefit surveys, both for Germany and Switzerland, have been remarkably stable over time.[15] As a result, the differences in costs and benefits of apprenticeship training between the two countries have been persistent as well.

For the first time, it is now possible to make use of a merged data set with observations at the firm-level to find an explanation for the large difference in the net costs of training between the two countries. In our analysis we have shown that a large part of this difference can be explained with relatively few parameters of the cost-benefit model. The strongest parameter in this respect is the use of time at the workplace. Swiss apprentices are engaged more often in productive work compared to their German counterparts.[16]

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[15] Von Bardeleben et al. (1995) calculate net costs of 9132 € p.a. and per apprentice, whereas the study by Beicht et al. (2004) reports net costs of 8705 €. For Switzerland, Schweri et al. (2003) find an average net benefit of training of 1353 € p.a. and per apprentice, whereas Muehlemann et al. (2007) report an average net benefit of 1787 €.

[16] The relatively low amount of productive work of German apprentices had already been highlighted in a comparison of German and French apprentices in the study of Fougère and

The open question that still needs to be addressed is why such a large fraction of German firms is willing to incur net costs. Based on our results, firms could adjust the most relevant parameters that are responsible for part of the substantial net costs of training, i.e., the share of productive and non-productive work allocated to apprentices at the workplace. A possible explanation might be found in the differences of labor market regulations between the two countries. Due to the very high flexibility of the Swiss labor market, most Swiss companies seem to be forced to apply a production-oriented training strategy, whereas labor market regulations allow most German firms to apply an investment-oriented training strategy (see Lindley 1975 for a first discussion of these two strategies).[17]

The mobility of apprentices after graduation is in line with this hypothesis. On average, only 36% of Swiss apprentices remain within the training firm one year after graduation in the year 2000 (see Wolter and Schweri 2002). In Germany, the corresponding value is more than 50% (64% in West Germany and 46% in East Germany, see Bundesministerium für Bildung und Forschung 2002). This could explain, why there is less pressure on German firms to productively use their apprentices during the training period. However, it is difficult to explain why not more of the German companies go for a double dividend, that is combining net benefits (or at least lower net costs) during training with benefits after training that arise due to the compressed wage structure induced by labor market institutions (see Acemoglu and Pischke 1998, 1999a, b, Dustmann and Schönberg 2008 or Winkelmann 1996). A possible reason for the relative reluctance of German firms to substitute skilled or even unskilled work by apprentices might be the strength and behavior of trade unions or work councils. An increased productive contribution of apprentices would make jobs for unskilled or low-skilled workers obsolete, and hence increase unemployment for these worker groups, at least in a static view of the economy. However, net costs of training are – as was shown in recent research (see section 1) – an important determinant of the firm's decision to train apprentices. Hence, there is a trade-off between unemployment and the number of apprenticeship posts, even if we would adopt a static view of the labor market.[18]

Schwerdt (2002) using the IAB-establishment panel for Germany and applying a production function approach.

[17] For a discussion of different training strategies of German firms see also Büchel and Neubäumer (2001). Franz and Zimmermann (2002) conclude that firms are interested to employ apprentices in order to obtain a return on their investment. Mohrenweiser and Backes-Gellner (2008) find, on the basis of the IAB establishment panel, that only 18% of German firms seem to follow a production-oriented (or substitution) strategy. Firms following a substitution strategy are defined by a within-firm-retention rate that is lower than 20 percent over three years. Wolter and Schweri (2002) show with Swiss data that following a similar reflection and without directly observing the net costs of training, that more than 70% of the Swiss firms training apprentices follow a production-oriented strategy. The comparison of the two results is in line with the results of studies that use directly observed net costs of training.

[18] A further aspect to be examined in the future are possible differences in the qualifications of apprentices, as these may have an impact on costs and benefits of apprenticeship training.

An important matter related to the time use of apprentices at the workplace are the implications on the quality of training. Trade unions, firms and policy makers might advocate against a more substantial involvement of apprentices in productive work. It might be the case that apprentices acquire some competencies only by performing non-productive tasks within the company, such as self-learning. It might well be possible that these competencies are also of importance to the employer, and therefore a firm would be willing to incur substantial net costs of training. However, as was shown in section 2.4, the relative performance of apprentices at the end of their training period seems to be identical in both countries. Hence, it would be difficult to argue that the benchmarks for comparison are much higher in Germany than in Switzerland. In any case, while the impact of the time and work allocation on the net costs of training is clear, its potential influence on the quality of learning and long-term employment opportunities is open for future research.

6. Conclusions

The difference in the net costs of training apprentices from the firm's perspective between Germany and Switzerland amounts to 25,000 € for a three-year training program. Using econometric matching methods, we have shown that this large difference is due to differences in relative wages, different regulations of the vocational education and training systems and, most importantly, to how a firm allocates tasks to its apprentices, being either activities with a productive value or activities that do not result in a productive value for the firm. Since a firm can influence the allocation of productive tasks to its apprentices to a large degree, it is important to understand why a majority of German firms is willing to bear substantial net costs of training. While our data does not provide a direct answer to this question, we can still draw important implications. Employment protection legislation is much less pronounced in Switzerland than in Germany, hence Swiss firms are forced to train apprentices in a cost-efficient manner. Furthermore, the more pronounced wage differential between apprentices and unskilled and skilled labor in Switzerland is an incentive for Swiss firms to apply a production-oriented instead of an investment-oriented training strategy. However, a further deregulation of the German labor market might force firms to allocate a higher share of productive tasks to their apprentices.

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Appendix: Figure and Tables

Figure A.1: Histogram of net costs*
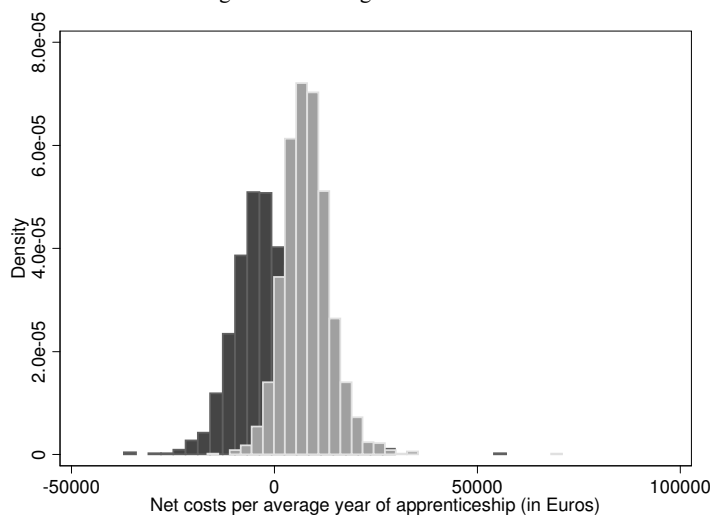
* dark grey = Switzerland. light grey = Germany.

Table A.1: Descriptive statistics, German firms

Variable	Mean	Std. Dev.	Min	Max	Obs
Cost per year and per apprentice c_i (in €)	15536.230	5016.783	5494	81026	1825
Benefit per year and per apprentice b_i (in €)	8008.260	3974.080	0	31894	1825
Net cost per year and per apprentice C_i (in €)	7527.971	5564.885	−16496	70987	1825
Yearly wage of management (in €)	40860.804	13908.768	7980	184068	1825
Yearly wage of full-time training personnel (in €)	36414.66	2402.688	22092	62580	1825
Yearly wage of skilled workers w_s (administrative, in €)	24141.48	5437.272	9204	73632	1825
Yearly wage of skilled workers w_s (technical / social, in €)	27348.06	6350.22	1040	61356	1825
Yearly wage of skilled workers w_s (crafts, in €)	22742.544	4256.34	7368	49080	1825
Yearly wage of unskilled workers w_u (no voc. degree, in €)	17790.528	3894.036	5892	36816	1825
Non-wage labor costs (in %)	37.252	10.737	8	75	1825
Yearly wage costs for apprentices w_{a1} (1st year, in €)	7232.920	1945.024	1071	16069	1065
Yearly wage costs for apprentices w_{a2} (2nd year, in €)	8229.483	2141.398	3675	18745	1168
Yearly wage costs for apprentices w_{a3} (3rd year, in €)	9191.676	2377.987	1335	20967	1063
Vacation days (1st year)	27.330	2.715	24	35	1065
Vacation days (2nd year)	27.440	2.603	24	35	1168
Vacation days (3rd year)	27.202	2.872	16	35	1063
Days in vocational school (1st year)	66.112	17.783	39	100	1065
Days in vocational school (2nd year)	61.160	18.035	39	100	1168
Days in vocational school (3rd year)	58.173	17.982	20	100	1063
Days at the workplace h_1 (1st year)	134.101	32.530	0	187	1065
Days at the workplace h_2 (2nd year)	138.129	32.086	0	187	1168
Days at the workplace h_3 (3rd year)	142.350	31.912	0	194	1063

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Variable	Mean	Std. Dev.	Min	Max	Obs
Share of unskilled productive tasks α_1 (1st year)	29.977	19.084	0	100	1065
Share of unskilled productive tasks α_2 (2nd year)	31.524	17.874	0	100	1168
Share of unskilled productive tasks α_3 (3rd year)	27.790	18.374	0	95	1063
Share of productive tasks (skilled, 1st year)	13.256	15.879	0	100	1065
Share of productive tasks (skilled, 2nd year)	25.834	19.399	0	100	1168
Share of productive tasks (skilled, 3rd year)	41.238	22.937	0	100	1063
Share of tasks with no direct value to firm (1st year)	56.974	23.297	10	110	1065
Share of tasks with no direct value to firm (2nd year)	42.927	19.885	7	100	1168
Share of tasks with no direct value to firm (3rd year)	31.349	17.960	5	100	1063
Relative productivity γ_1 (1st year)	30.240	15.049	5	100	1065
Relative productivity γ_2 (2nd year)	46.713	18.278	5	100	1168
Relative productivity γ_3 (3rd year)	68.332	21.988	5	100	1063
Hours of firm-training per apprentice h_t / week	5.436	2.855	0	36	1825
Firm size:					
1 – 9 employees	0.463		0	1	1825
10 – 49 employees	0.396		0	1	1825
50 – 99 employees	0.068		0	1	1825
100+ employees	0.073		0	1	1825
Company training center (yes / no)	0.015		0	1	1825
Full-time training personnel (yes / no)	0.024		0	1	1825
Industry:					
Agriculture	0.039		0	1	1825
Manufacturing	0.181		0	1	1825

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Variable	Mean	Std. Dev.	Min	Max	Obs
Energy, water supply	0.001		0	1	1825
Construction	0.105		0	1	1825
Trade, automotive industry	0.181		0	1	1825
Restaurant and hotel	0.045		0	1	1825
Transport and communication	0.020		0	1	1825
Credit and insurance	0.022		0	1	1825
Real estate, IT, R&D, Services	0.112		0	1	1825
Public administration, national security social insurance	0.024		0	1	1825
Health and welfare	0.117		0	1	1825
Other public or personal services	0.154		0	1	1825
Occupation categories:					
Nature	0.088		0	1	1825
Food, restaurant & hotels, home economics	0.117		0	1	1825
Textiles, clothing, hygiene	0.038		0	1	1825
Construction	0.144		0	1	1825
Manufacturing, craft (technical), IT	0.097		0	1	1825
Trade, public administration	0.364		0	1	1825
Education, health, social work	0.135		0	1	1825
Media, art, social sciences	0.017		0	1	1825

Table A.2: **Descriptive statistics, Swiss firms**

Variable	Mean	Std. Dev.	Min	Max	Obs
Cost per year and per apprentice c_i (in €)	18130.710	7137.790	6282	66720	1471
Benefit per year and per apprentice b_i (in €)	19043.530	5863.084	2748	60803	1471
Net cost per year and per apprentice C_i (in €)	−912.818	8097.626	−37076	57164	1471
Yearly wage of management (in €)	59857.044	19219.128	23292	232872	1471
Yearly wage of full-time training personnel (in €)	45112.716	8137.380	23292	116436	1471
Yearly wage of skilled workers w_s (administrative, in €)	38630.448	7730.520	15528	139728	1471
Yearly wage of skilled workers w_s (technical / social, in €)	41858.484	6803.112	23292	95388	1471
Yearly wage of skilled workers w_s (crafts, in €)	38930.700	7764.276	15528	120936	1471
Yearly wage of unskilled workers w_u (no voc. degree in €)	28214.532	4875.144	13968	49968	1471
Non-wage labor costs (in %)	22.991	9.441	15	50	1471
Yearly wage costs for apprentices w_{a1} (1st year, in €)	5889.078	2175.177	1979	33188	1006
Yearly wage costs for apprentices w_{a2} (2nd year, in €)	7773.313	2489.260	2573	27779	927
Yearly wage costs for apprentices w_{a3} (3rd year, in €)	10172.420	2701.514	2492	29955	886
Vacation days (1st year)	26.305	3.970	20	35	1006
Vacation days (2nd year)	26.429	3.552	20	35	927
Vacation days (3rd year)	26.797	3.753	20	35	886
Days in vocational school (1st year)	50.806	17.977	36	188	1005
Days in vocational school (2nd year)	50.839	14.690	36	80	927
Days in vocational school (3rd year)	50.299	14.073	36	80	886
Days at the workplace h_1 (1st year)	156.694	26.183	0	194	1006
Days at the workplace h_2 (2nd year)	156.075	21.970	16	194	927
Days at the workplace h_3 (3rd year)	155.673	20.851	16	194	886

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Variable	Mean	Std. Dev.	Min	Max	Obs
Share of unskilled productive tasks α_1 (1st year)	50.432	20.824	0	100	1006
Share of unskilled productive tasks α_2 (2nd year)	39.398	17.817	0	90	927
Share of unskilled productive tasks α_3 (3rd year)	28.224	17.901	0	90	886
Share of skilled productive tasks (1st year)	28.234	20.942	0	90	1006
Share of skilled productive tasks (2nd year)	45.430	19.475	0	100	927
Share of skilled productive tasks (3rd year)	58.467	19.671	0	100	886
Share of tasks with no direct value to firm (1st year)	21.334	19.154	0	90	1006
Share of tasks with no direct value to firm (2nd year)	15.172	12.322	0	70	927
Share of tasks with no direct value to firm (3rd year)	13.310	11.090	0	95	886
Relative productivity γ_1 (1st year)	36.526	20.631	5	100	1006
Relative productivity γ_2 (2nd year)	53.998	18.674	5	100	927
Relative productivity γ_3 (3rd year)	74.637	17.776	8	100	886
Hours of firm-training per apprentice h_t / week	6.582	4.712	0.4	20	1471
Firm size:					
1 – 9 employees	0.554		0	1	1471
10 – 49 employees	0.337		0	1	1471
50 – 99 employees	0.056		0	1	1471
100+ employees	0.052		0	1	1471
Company training center (yes / no)	0.003		0	1	1471
Full-time training personnel (yes / no)	0.044		0	1	1471
Industry:					
Manufacturing	0.067		0	1	1471
Energy, water supply	0.005		0	1	1471

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Variable	Mean	Std. Dev.	Min	Max	Obs
Construction	0.172		0	1	1471
Trade, automotive industry	0.247		0	1	1471
Restaurant and hotel	0.073		0	1	1471
Transport and communication	0.034		0	1	1471
Credit and insurance	0.044		0	1	1471
Real estate, IT, R&D, Services	0.076		0	1	1471
Public administration, national security social insurance	0.079		0	1	1471
Education	0.023		0	1	1471
Health and welfare	0.112		0	1	1471
Other public or personal services	0.069		0	1	1471
Occupation categories:					
Nature	0.037		0	1	1471
Food, restaurant & hotels, home economics	0.158		0	1	1471
Textiles, clothing, hygiene	0.058		0	1	1471
Construction	0.173		0	1	1471
Manufacturing, craft (technical), IT	0.053		0	1	1471
Trade, public administration	0.427		0	1	1471
Education, health, social work	0.081		0	1	1471
Media, art, social sciences	0.013		0	1	1471

Table A.3

OLS regressions, observed costs and benefits of apprenticeship training

Dep. variable: net costs of training	(1)	(2)	(3)	(4)	(5)
German firm	8,440.790	8,419.920	8,451.600	8,393.030	8,430.110
	(341.242)	(348.124)	(354.404)	(363.585)	(364.929)
10 – 49 employees		199.767	220.980	54.200	19.107
		(370.429)	(376.404)	(384.846)	(385.219)
50 – 99 employees		93.905	162.186	−174.137	−282.606
		(595.470)	(614.528)	(606.214)	(605.345)
100+ employees		391.134	279.571	−209.029	−628.357
		(415.817)	(437.950)	(473.382)	(492.070)
Industry:					
Manufacturing			2,366.010	970.504	920.371
			(641.992)	(1,029.978)	(1,031.866)
Energy, water supply			−316.896	−1,590.610	−1,698.850
			(1,733.012)	(1,858.260)	(1,874.528)
Construction			1,880.500	612.369	520.503
			(721.028)	(1,194.618)	(1,192.048)
Trade, automotive industry			1,477.740	109.714	22.190
			(635.753)	(939.205)	(945.611)
Restaurant and hotel			2,550.590	2,497.990	2,473.510
			(894.965)	(1,275.705)	(1,275.058)
Transport and communication			3,651.530	1,820.940	1,561.270
			(1,398.953)	(1,632.160)	(1,657.751)
Credit and insurance			3,638.580	2,059.820	1,931.520
			(1,099.665)	(1,366.846)	(1,370.024)
Real estate, IT, R&D, Services			2,521.980	553.959	441.937
			(691.622)	(1,078.059)	(1,078.730)
Public administration, national security social insurance			1,286.720	−278.372	−378.849
			(887.510)	(1,176.751)	(1,179.366)
Education			3,619.290	2,016.980	1,963.060
			(2,348.171)	(2,486.687)	(2,489.859)
Health and welfare			3,246.500	1,967.920	2,088.280
			(719.882)	(1,362.896)	(1,376.286)
Other public or personal services			2,027.510	426.637	363.075
			(651.300)	(1,046.911)	(1,047.613)
Occupation categories:					
Food, restaurant & hotels, home economics				54.141	−11.463
				(955.911)	(948.167)
Textiles, clothing, hygiene				697.250	737.004
				(1,081.841)	(1,078.933)
Construction				1,281.280	1,334.730
				(1,050.566)	(1,044.890)

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Dep. variable: net costs of training	(1)	(2)	(3)	(4)	(5)
Manufacturing, craft (technical), IT				3,165.840 (1,019.026)	3,139.490 (1,020.814)
Trade, public administration				1,699.870 (880.167)	1,814.790 (882.828)
Education, health, social work				1,387.390 (1,242.508)	1,233.130 (1,252.914)
Media, art, social sciences				7,558.310 (1,543.077)	7,618.330 (1,534.213)
Company training center (yes/no)					2,071.430 (1,733.244)
Full-time training personnel (yes/no)				2,324.600 (849.778)	
Constant	−912.818 (299.064)	−1,005.990 (306.055)	−3,205.990 (616.256)	−3,126.110 (616.175)	−3,165.940 (617.894)
Observations	3296	3296	3296	3296	3296
R^2	0.28	0.28	0.29	0.30	0.31

Robust standard errors in parentheses.

Table A.4

OLS regressions, simulated costs and benefits for Germany

Dep. variable: net costs of training	(1)	(2)	(3)	(4)	(5)
German firm	1,846.730 (349.941)	1,910.919 (356.250)	1,584.286 (364.609)	1,518.782 (375.699)	1,494.398 (377.170)
10 – 49 employees		−264.654 (379.584)	−226.310 (380.359)	−260.562 (390.564)	−304.467 (389.977)
50 – 99 employees		−977.910 (629.499)	−731.006 (626.952)	−745.597 (629.718)	−914.190 (629.618)
100+ employees		−1,807.712 (506.899)	−1,594.862 (509.864)	−1,663.611 (542.126)	−2,356.822 (549.135)
Industry:					
Manufacturing			−3,237.304 (622.485)	−4,030.593 (987.465)	−4,058.566 (1,006.949)
Energy, water supply			−7,094.034 (1,711.394)	−7,357.039 (1,828.870)	−7,406.507 (1,858.995)
Construction			−4,455.558 (732.091)	−4,315.206 (1,170.478)	−4,386.021 (1,189.389)
Trade, automotive industry		−5,203.741 (640.990)	−5,899.106 (888.674)	−5,900.113 (909.220)	

continued next page

Dep. variable: net costs of training	(1)	(2)	(3)	(4)	(5)
Restaurant and hotel			−2,024.355 (875.323)	−2,601.958 (1,239.204)	−2,478.782 (1,250.215)
Transport and communication			−2,861.304 (1,380.569)	−3,567.934 (1,586.977)	−3,948.424 (1,595.350)
Credit and insurance			−3,906.623 (1,072.804)	−4,436.078 (1,317.263)	−4,473.206 (1,333.070)
Real estate, IT, R&D, Services			−4,044.649 (674.649)	−4,796.523 (1,038.439)	−4,912.206 (1,051.969)
Public administration, national security social insurance			−6,022.158 (886.400)	−6,570.551 (1,143.894)	−6,602.394 (1,159.374)
Education			−2,603.327 (2,342.277)	−3,087.283 (2,476.487)	−3,170.455 (2,489.077)
Health and welfare			−2,169.132 (732.651)	−4,187.130 (1,413.714)	−3,587.140 (1,377.367)
Other public or personal services			−4,725.082 (648.707)	−5,739.618 (1,028.784)	−5,695.255 (1,051.281)
Occupation categories:					
Food, restaurant & hotels, home economics				585.880 (930.652)	448.536 (929.231)
Textiles, clothing, hygiene				650.378 (1,067.551)	623.867 (1,075.845)
Construction				−261.216 (1,017.339)	−257.672 (1,021.753)
Manufacturing, craft (technical), IT				1,674.650 (1,007.161)	1,455.780 (1,009.980)
Trade, public administration				526.824 (846.437)	627.074 (852.247)
Education, health, social work				2,228.979 (1,333.208)	1,595.842 (1,268.695)
Media, art, social sciences				6,962.142 (1,516.964)	7,004.361 (1,515.669)
Company training center (yes / no)					8,567.197 (1,539.037)
Full-time training personnel (yes / no)					1,525.095 (919.606)
Constant	−912.818 (299.064)	−673.885 (309.378)	3,414.702 (608.711)	3,461.746 (615.555)	3,436.260 (626.962)
Observations	3296	3296	3296	3296	3296
R^2	0.02	0.02	0.05	0.07	0.09

Robust standard errors in parentheses.

Table A.5

OLS regressions, simulated costs and benefits for Switzerland

Dep. variable: net costs of training	(1)	(2)	(3)	(4)	(5)
German firm	−390.140	−421.420	−160.860	−180.680	−146.190
	(259.280)	(265.053)	(269.393)	(269.878)	(269.847)
10 – 49 employees		166.783	211.124	−84.870	−119.006
		(291.019)	(292.243)	(289.056)	(288.966)
50 – 99 employees		117.168	−6.093	−612.068	−718.314
		(495.079)	(502.888)	(488.326)	(486.070)
100+ employees		971.863	488.801	−344.109	−755.769
		(387.646)	(391.754)	(414.358)	(435.082)
Industry:					
Manufacturing			2,350.660	775.528	727.540
			(619.503)	(902.154)	(910.658)
Energy, water supply			4,400.846	2,962.614	2,859.256
			(1,128.537)	(1,254.483)	(1,259.600)
Construction			1,716.632	496.866	408.493
			(630.694)	(1,011.844)	(1,022.267)
Trade, automotive industry			1,696.115	−12.274	−94.984
			(611.050)	(840.415)	(851.101)
Restaurant and hotel			504.710	240.190	219.820
			(728.777)	(1,022.957)	(1,026.416)
Transport and communication			3,111.870	776.030	522.210
			(1,086.998)	(1,280.718)	(1,308.864)
Credit and insurance			6,317.404	4,227.744	4,105.709
			(807.537)	(1,052.044)	(1,060.940)
Real estate, IT, R&D, Services			2,183.327	−169.936	−278.355
			(634.284)	(929.415)	(936.987)
Public administration, national security social insurance			4,175.946	2,195.305	2,099.668
			(661.890)	(916.258)	(923.419)
Education			4,673.543	2,602.036	2,549.236
			(1,683.421)	(1,786.396)	(1,789.680)
Health and welfare			3,225.701	2,709.745	2,836.877
			(688.774)	(1,163.612)	(1,173.615)
Other public or personal services			1,912.339	369.940	310.883
			(634.343)	(939.151)	(944.165)
Occupation categories:					
Food, restaurant & hotels, home economics				316.100	251.050
				(756.271)	(758.633)
Textiles, clothing, hygiene				105.724	142.688
				(902.087)	(903.658)
Construction				1,175.710	1,226.291
				(837.144)	(846.806)

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Dep. variable: net costs of training	(1)	(2)	(3)	(4)	(5)
Manufacturing, craft (technical), IT				3,572.716 (818.459)	3,542.930 (827.119)
Trade, public administration				2,320.359 (714.681)	2,431.174 (724.757)
Education, health, social work				477.830 (1,050.409)	317.940 (1,057.123)
Media, art, social sciences				6,182.341 (1,049.710)	6,239.991 (1,043.819)
Company training center (yes / no)					2,148.577 (1,710.082)
Full-time training personnel (yes / no)					2,230.240 (813.046)
Constant	7,918.108 (200.547)	7,804.317 (215.430)	5,416.413 (576.043)	5,515.731 (573.453)	5,477.531 (574.691)
Observations	3296	3296	3296	3296	3296
R^2	0.00	0.00	0.05	0.08	0.09

Robust standard errors in parentheses.

Table A.6

ATT and ATC on wages

Variable	ATT	ATC
Yearly wage of management	−21680.556 (1308.636)	−21680.556 (1402.368)
Yearly wage of full-time training personnel	−10101.420 (518.712)	−12179.844 (637.272)
Yearly wage of skilled workers (administrative)	−14965.968 (532.872)	−16175.508 (689.136)
Yearly wage of skilled workers (technical / social)	−15508.836 (547.920)	−15986.532 (603.180)
Yearly wage of skilled workers (crafts)	−16441.476 (439.992)	−17253.180 (505.560)
Yearly wage of unskilled workers (no voc. degree)	−11055.648 (352.308)	−11209.200 (399.132)
Non-wage labor costs (in %)	14.258 (0.851)	14.496 (0.950)
Yearly wage costs for apprentices (1st year)	1817.070 (163.334)	1903.519 (230.941)
Yearly wage costs for apprentices (2nd year)	812.026 (229.600)	1216.873 (229.385)
Yearly wage costs for apprentices (3rd year)	−1064.446 (306.396)	−671.096 (219.710)

Standard errors in parentheses.

Table A.7

ATT and ATC on parameters related to the VET-system

Variable	ATT	ATC
Vacation days (1st year)	1.201 (0.248)	0.914 (0.333)
Vacation days (2nd year)	0.894 (0.281)	1.242 (0.286)
Vacation days (3rd year)	0.712 (0.318)	0.950 (0.269)
Days in vocational school (1st year)	11.528 (1.304)	11.947 (1.758)
Days in vocational school (2nd year)	8.463 (1.454)	6.770 (1.513)
Days in vocational school (3rd year)	7.283 (1.698)	4.112 (1.423)
Internal courses (hours / year, 1st year)	12.310 (4.264)	7.711 (4.954)
Internal courses (hours / year, 2nd year)	2.337 (5.664)	3.233 (4.695)
Internal courses (hours / year, 3rd year)	3.479 (5.632)	2.191 (4.052)
Internships in other establishments (1st year)	2.280 (1.036)	0.826 (1.259)
Internships in other establishments (2nd year)	1.967 (1.250)	1.874 (1.449)
Internships in other establishments (3rd year)	0.072 (1.258)	0.739 (1.190)
Sick days (1st year)	2.848 (0.451)	2.623 (0.587)
Sick days (2nd year)	1.725 (0.644)	1.938 (0.683)
Sick days (3rd year)	2.044 (0.634)	1.841 (0.579)
External courses (days, 1st year)	1.032 (1.655)	1.187 (1.829)
External courses (days, 2nd year)	4.051 (1.542)	2.481 (1.526)
External courses (days, 3rd year)	1.065 (1.975)	5.326 (1.747)

Standard errors in parentheses.

Table A.8

ATT and ATC on task-allocation

Variable	ATT	ATC
Share of tasks with no productive value (1st year)	−21.838 (1.522)	−22.916 (1.949)
Share of tasks with no productive value (2nd year)	−8.375 (1.663)	−7.828 (1.676)
Share of tasks with no productive value (3rd year)	−4.770 (1.975)	−1.544 (1.588)
Share of tasks with no productive value (1st year)	−14.778 (1.426)	−14.652 (1.778)
Share of tasks with no productive value (2nd year)	−19.182 (1.790)	−20.703 (1.818)
Share of tasks with no productive value (3rd year)	−12.339 (2.457)	−17.298 (1.907)
Share of tasks with no productive value (1st year)	36.751 (1.523)	37.629 (1.998)
Share of tasks with no productive value (2nd year)	27.800 (1.567)	28.696 (1.489)
Share of tasks with no productive value (3rd year)	17.416 (1.742)	9.196 (1.405)

Standard errors in parentheses.